

Exemplary Responses and Examples of Common Errors found on the Performance-Based Section of the Intermediate-Level Science MAP Assessment

The performance-based event session of the MAP Assessment is focused on understandings of experimental design and inquiry. The intermediate-level assessment expects students to be able to design experiments, analyze and evaluate experimental design, and analyze the results and conclusions drawn from experiments involving multiple independent variables. In order to improve student achievement on the MAP assessment, teachers are encouraged to:

- use the Science Performance Event Template (which includes standardized prompts and scoring guides) to inform classroom instruction and assessment practices,
- use assessment released items and corresponding anchor papers to become familiar with test item format and expectations,
- align instruction and assessment with the Science Grade-Level Expectations and supporting documents, and
- regularly involve students in learning experiences that incorporate inquiry methods.

Students and Research, authored by Cothran, J. H., Giese, R. N., and Rezba, R. J. (2000, Dubuque, IA: Kendall/Hunt Publishing), is recommended as an excellent resource for use as teachers develop understandings of open-inquiry and experimental design.

This document is designed to provide clarification of expectations for selected key elements of experimental design regularly assessed on the Science MAP assessment. The standardized prompt and scoring guides are provided, along with examples of common errors and anchor papers (examples of student work with scoring annotations). Teachers are encouraged to share and adopt these standards across classrooms and to expect mastery of inquiry skills by all students.

Each MAP Performance-based event is developed as a module of questions focusing on a specific experimental scenario. A review of standardized prompts and scoring guides, with common errors, for selected Performance event module items is provided. These are followed by samples of modules with examples of student responses.

Using Released Items with Colleagues and Students

#1 To familiarize students/teachers with the format and expectations of the performance-event component of the MAP test

A booklet of released items can be used as a “package” to give students/teachers an overview of the test as a whole, so they can see the variety of questioning strategies used. In Science and Communication Arts in particular, items are linked and students need to learn how to refer back to stimulus material or the initial prompt.

#2 To train students in self-evaluation and proofreading

Teachers should use the released items for the performance events (for example, the word problem in Mathematics, the writing prompt in Communication Arts, the experimental design module in Science) and respective anchor papers to train students how to use the prompt and scoring guides to evaluate their own work and the work of other students. This is a very important step in improving student achievement. The following is a recommended process.

- a. Use post-it notes to cover the annotations and scores on the student anchor papers, then make transparencies of the problem (item prompt), the scoring guides, and the student anchor papers. Make paper copies of the problem and the scoring guide for student use.
- b. Distribute paper copies of the problem for students to work individually.
- c. Distribute copies of the scoring guide and review it with the class.
- d. Have students use the scoring guide to determine a score for their own paper (privately). If they think they have made a mistake, have them articulate the mistake on the paper or on a post-it note. The students’ own annotated papers should be set aside.
- e. Put up a transparency of one of the anchor papers. Be sure the score and annotations are not visible. Have students work in pairs to score the sample work. Remind them that they need to refer to the scoring guide and stay true to its expectations.
- f. As a class, discuss the scores assigned to the work by the students. Students must be able to defend the scores they gave based on the scoring guide.
- g. Repeat this process with the rest of the samples.
- h. Have students return to their own work and decide if the score they initially gave themselves needs to be revised.
- i. Students should be able to articulate what changes need to be made in their work in order to earn credit for an exemplary response.

#3 To establish standardized expectations for students across classrooms

Teachers should experience the procedure described above using a packet of released items, scoring guides, and anchor papers. After completion of steps a – g, teachers should use MAP-like scoring guides to blind-score sets of students’ work. After participating teachers have scored the set of papers, they should compare assigned scores. Discrepancies indicate the need to standardize expectations from one class to the next and/or to adopt MAP-like test formats, prompts and scoring guides for regular classroom use. Analysis of student scores may indicate the need to revise curriculum and assessments to better prepare students for mastery of expectations.

What is the effect of friction on distance traveled?

Carlos and Kim did a science project about friction, testing different surfaces on a ramp. They wondered if surfaces with more friction would slow toy cars down so that they would not travel as far. They decided to test three surfaces, sand paper, waxed paper, and painted wood, using the following procedure:

1. They made a wooden ramp and covered the ramp with paint.
2. They held a toy car at a starting line at the top of the ramp and then released it.
3. Using a metric ruler, they measured how far the car rolled after it left the ramp and recorded their results.
4. They repeated steps 2 and 3 using waxed paper on top of the painted surface.
5. They repeated steps 2 and 3 using sandpaper on top of the painted surface.



1. Write a reasonable hypothesis for the experiment that Carlos and Kim conducted.

2. What is the independent variable in this experiment?

What is the dependent variable in this experiment?

Carlos and Kim recorded the data from their experiment in the data table below:

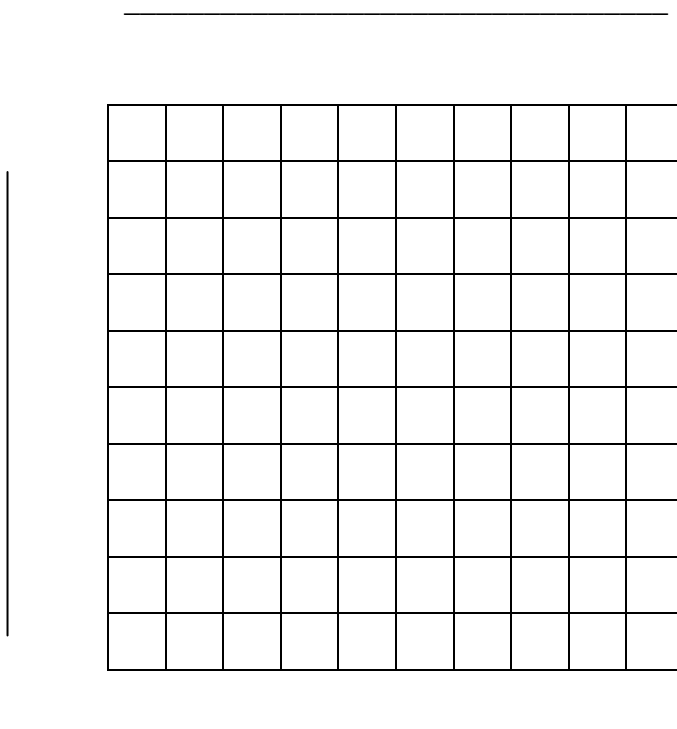
Table 1

Surface of the Ramp	Distance Car Traveled (cm)					Average Distance (cm)
	Trials					
Sand paper	45	50	47	51	47	48
Waxed paper	92	98	94	95	96	95
Paint	80	82	80	84	79	81

3. Use the data from Table 1 to construct a bar graph on the grid below. Graph only the averages of the distance measurements.

Be sure to provide:

- an appropriate title
- a label for each axis with appropriate units
- an appropriate number scale and category labels
- correctly plotted data



4. Use the data from the data table and graph to write a conclusion for the experiment on friction.

Identifying Independent and Dependent Variables

A hypothesis with only a prediction of main effect should be tested by an experiment in which only one variable is changed at a time. All other variables should be kept unchanged, or controlled. Students are expected to be able to distinguish between the following elements of a properly designed experiment:

- a. The variable that is purposely manipulated (changed) by the experimenter is called the **independent variable**. This is the factor believed to have a main effect on the predicted results.
- b. The variable that changes in response to the independent variable and is observed (collected as data) is called the **dependent variable**.
- c. **Constants** are all factors that remain the same and have a fixed value. Their purpose is to isolate the factor (independent variable) that can affect the results.
- d. **Control** (or control group) is the standard for comparing experimental results. The experimental setup (group) either does not contain the independent variable or provides a baseline value for the independent variable.

Exemplary Response:

2. What is the independent variable in this experiment?

Type of Surface

What is the dependent variable in this experiment?

Distance Traveled

Common errors

- Independent and Dependent variables are reversed.
- Responses indicate that students do not understand the definitions and purposes of the different elements of the experiment and cannot distinguish between them.

ANCHOR PAPERS FOR SCORING BAR GRAPH ITEMS

Generic Scoring Guide for BAR GRAPH, Grade 8

(10x10 grid provided with horizontal lines/spaces for labeling of axes and title, prompt designates bar graph to be constructed)

Four Total Points

One point for each of the following:

- **Appropriate title:** a statement of the relationship between the independent and dependent variables or a statement of what is being tested
- **Both axes correctly labeled, with units** if appropriate
- **Appropriate number scale written along axis:** numbers on the gridlines, numbers that allow all data to be plotted, consistently scaled

AND

- **appropriate category labels written along axis below bars**
- **All data points correctly plotted**

Prompt for bar graph reads:

Use the data from Table ____ to construct a bar graph on the grid below. (Customized information related to data to be plotted may be provided.)

Be sure to provide:

- **an appropriate title**
- **a label for each axis with appropriate units**
- **an appropriate number scale and category labels**
- **correctly plotted data**

Common errors on Bar Graph

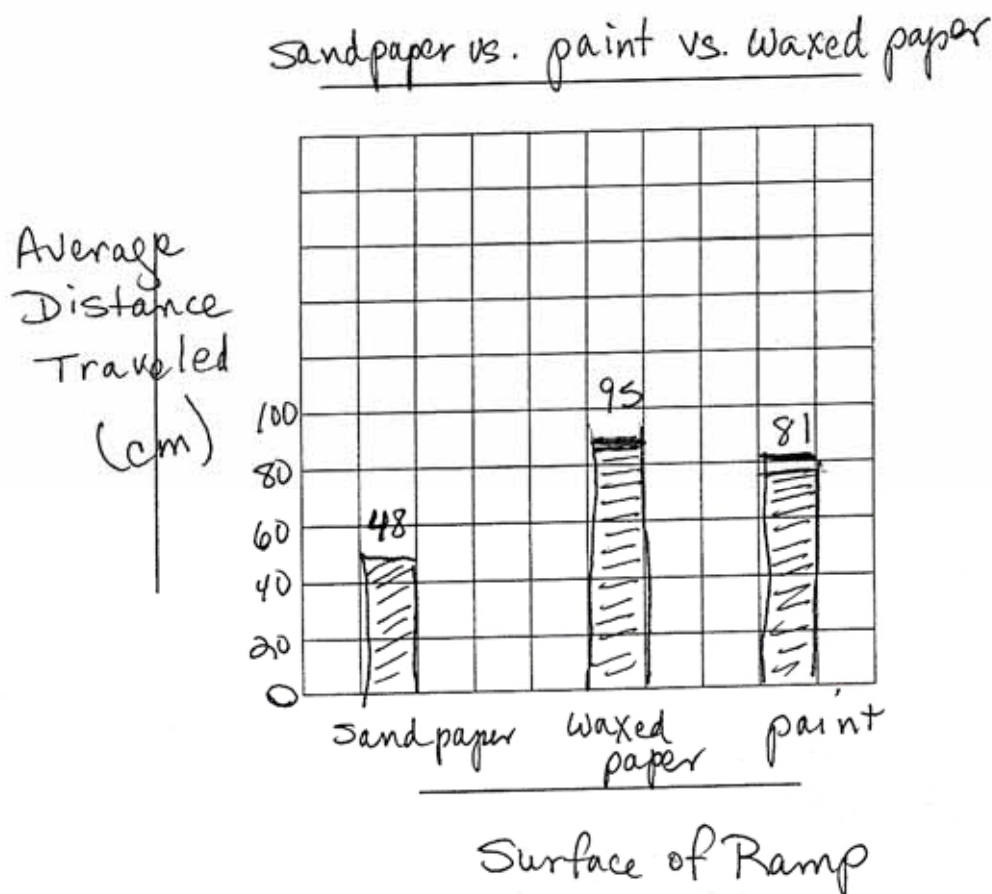
- Zero or only some bars are plotted correctly
- Bars are not plotted above correct category labels
- Bar does not extend to correct number value (e.g., top of the bar cannot be distinguished, bar stops short of or extends beyond data value)
- Points are plotted instead of bars
- Numbering of y-axis is not consistently scaled
- Numbering scale does not allow for plotting of data
- Number values along y-axis are not aligned with grid lines (e.g., written between lines so that value of line cannot be distinguished)
- Categories of the independent variable
 - are not labeled along x-axis
 - do not match those provided by the data

Graph 1

2 points

- a label for each axis with appropriate units
 - an appropriate number scale and category labels
- Title is unacceptable
 - Incorrect plotting of 95 cm (Compressing the number scale made it very difficult for the student to plot the data)

Suggestion: Give students practice in determining a useful number scale that will use up as much space on the graph as possible, allowing them more range in plotting.

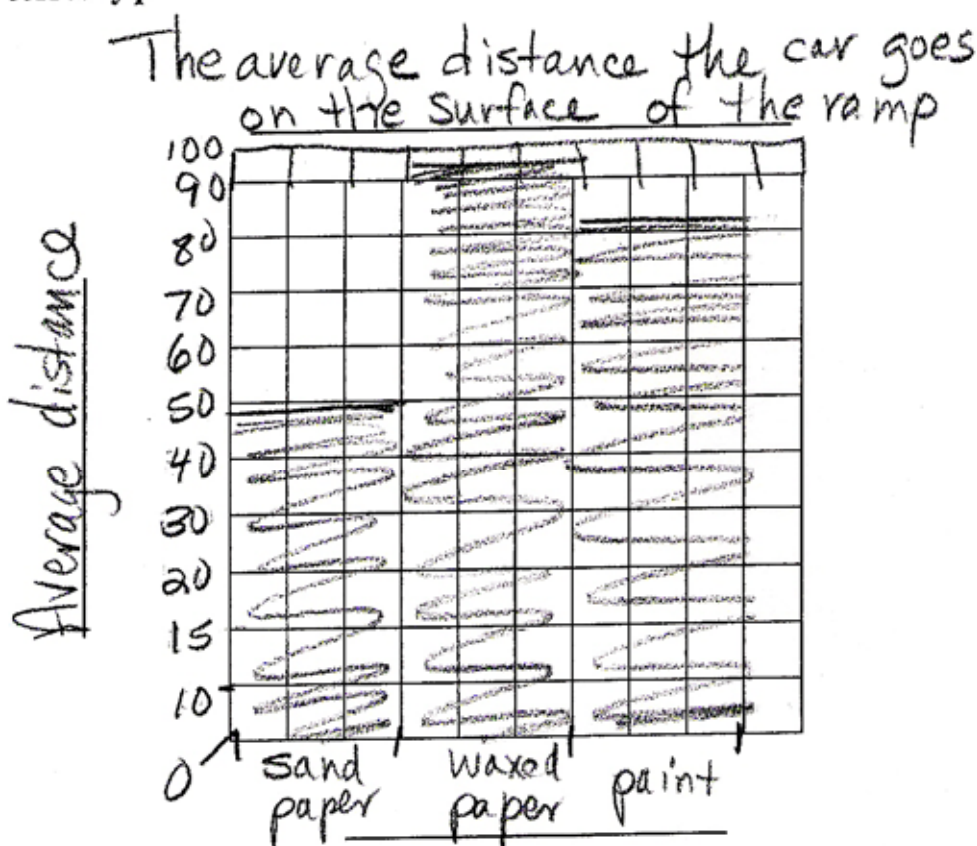


Graph 2

2 points

- an appropriate title
 - correctly plotted data
- Missing units from label
 - Number intervals are inconsistent. It appears that the student began with a scale in mind, saw that it wouldn't fit, and switched to a new scale. (It is acceptable to add the row on the top; however, it is not recommended. The student did not lose points for the additional grid line.)

Suggestion: Give students practice in determining a useful number scale.

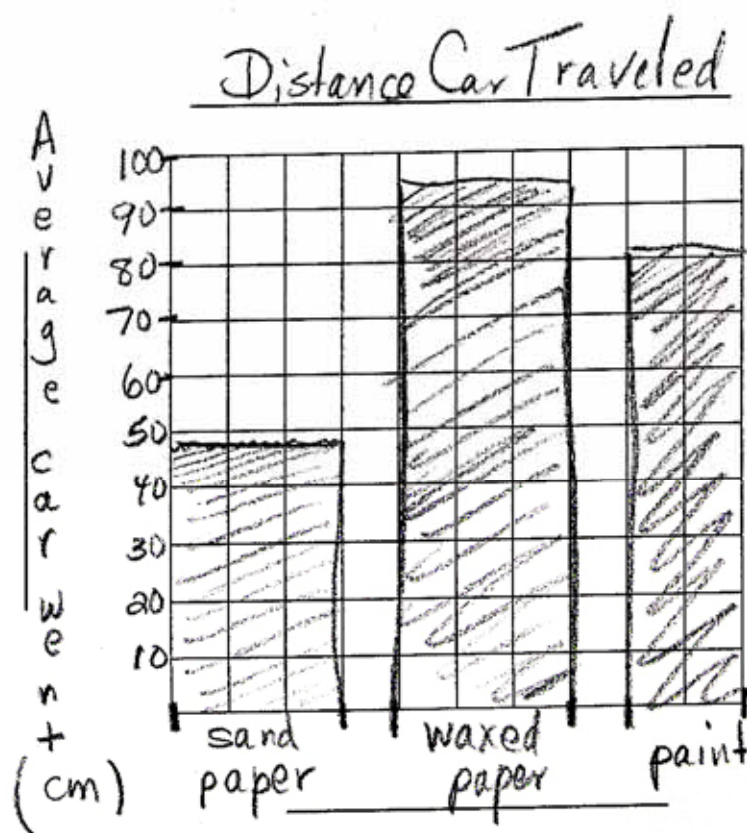


Graph 3

3 points

- a label for each axis with appropriate units
 - an appropriate number scale and category labels
 - correctly plotted data
- Unacceptable title

Suggestion: Give students practice in determining the independent and dependent variables. A good title reflects what is being manipulated (i.e., the surface) and what is being measured (i.e., the distance the car traveled in cm).



Graph 4

1 point

- correctly plotted data

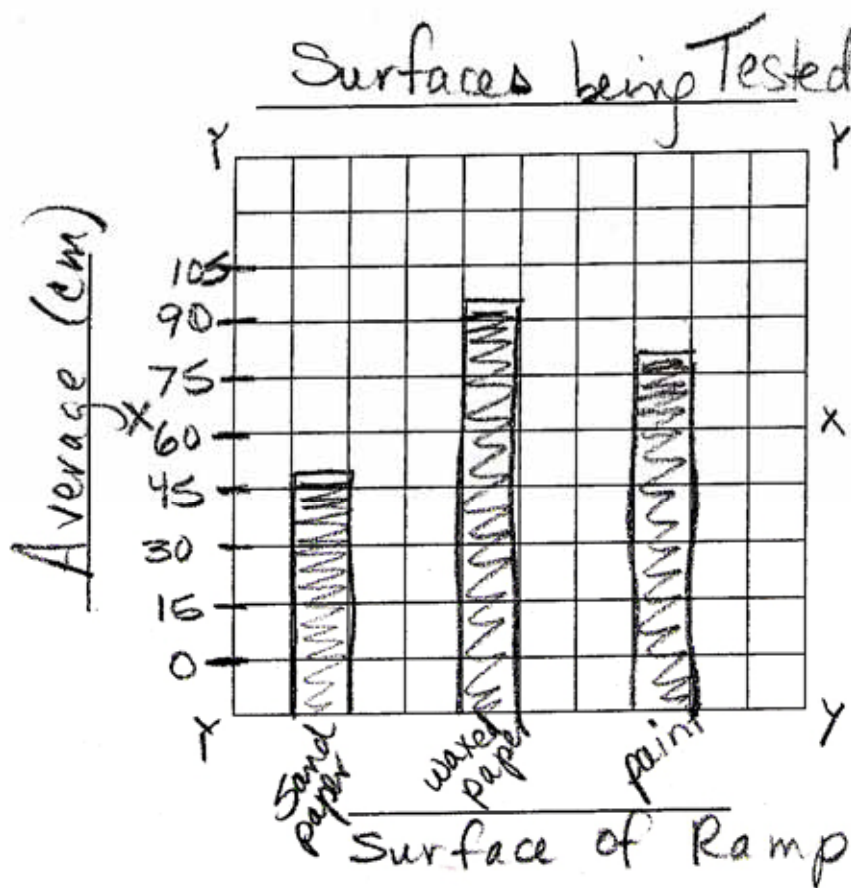
- Title is unacceptable
- “Average (cm)” label is unacceptable as an axis label (“average cm” of what?)
- Y-axis is not appropriately scaled (the bar graph cannot have a value for the independent variable less than zero in this case; it would mean that the cars roll up the ramp)

Suggestion:

Give students practice in determining the independent and dependent variables. A good title reflects what is being manipulated (i.e., the surface) and what is being measured (i.e., the distance the car traveled in cm).

Give students practice in proofreading and peer editing to see if each label makes sense independently of the graph and labels.

Have students evaluate the “reasonableness” of all plotted data values on the graph.

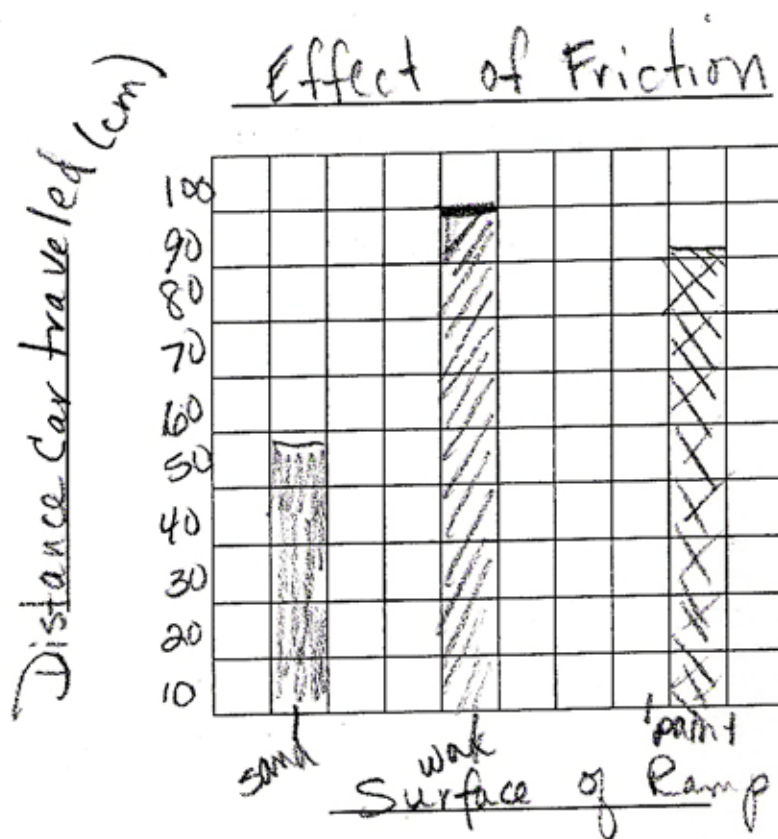


Graph 5

2 points

- an appropriate title
 - a label for each axis with appropriate units
- No point for intervals because the spaces between gridlines were labeled instead of the lines.
 - Because of the poorly numbered y-axis, the student became confused and failed to plot the data consistently. the 48 value (for sandpaper) can be given credit because of the “internal logic” of the number scale. however, the 95 value (for waxed paper) is not plotted correctly.

Suggestion: Students must be taught to label the axes with number values along the gridlines and NOT the spaces, even on a bar graph.

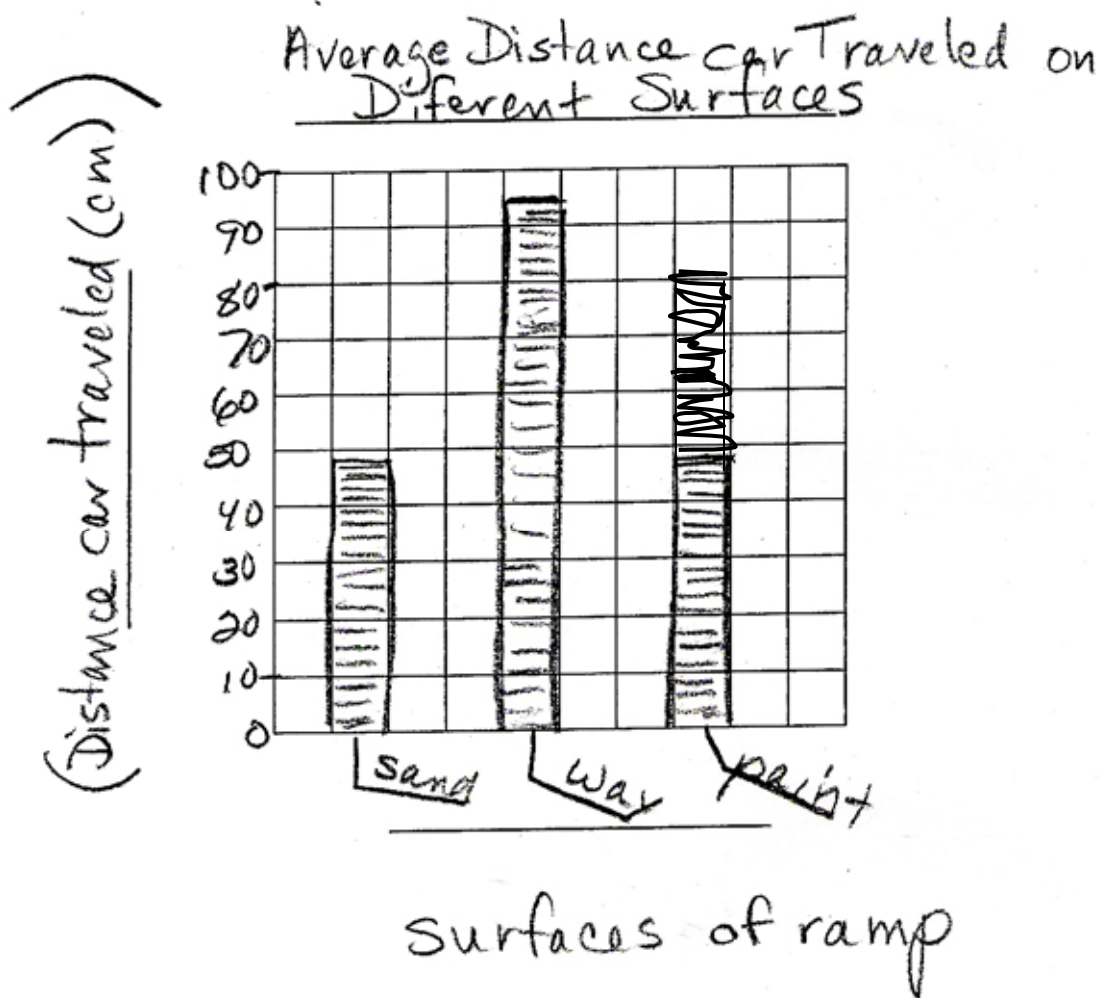


Graph 6

Exemplary Response:

4 points

- an appropriate title
- a label for each axis with appropriate units
- an appropriate number scale and category labels
- correctly plotted data

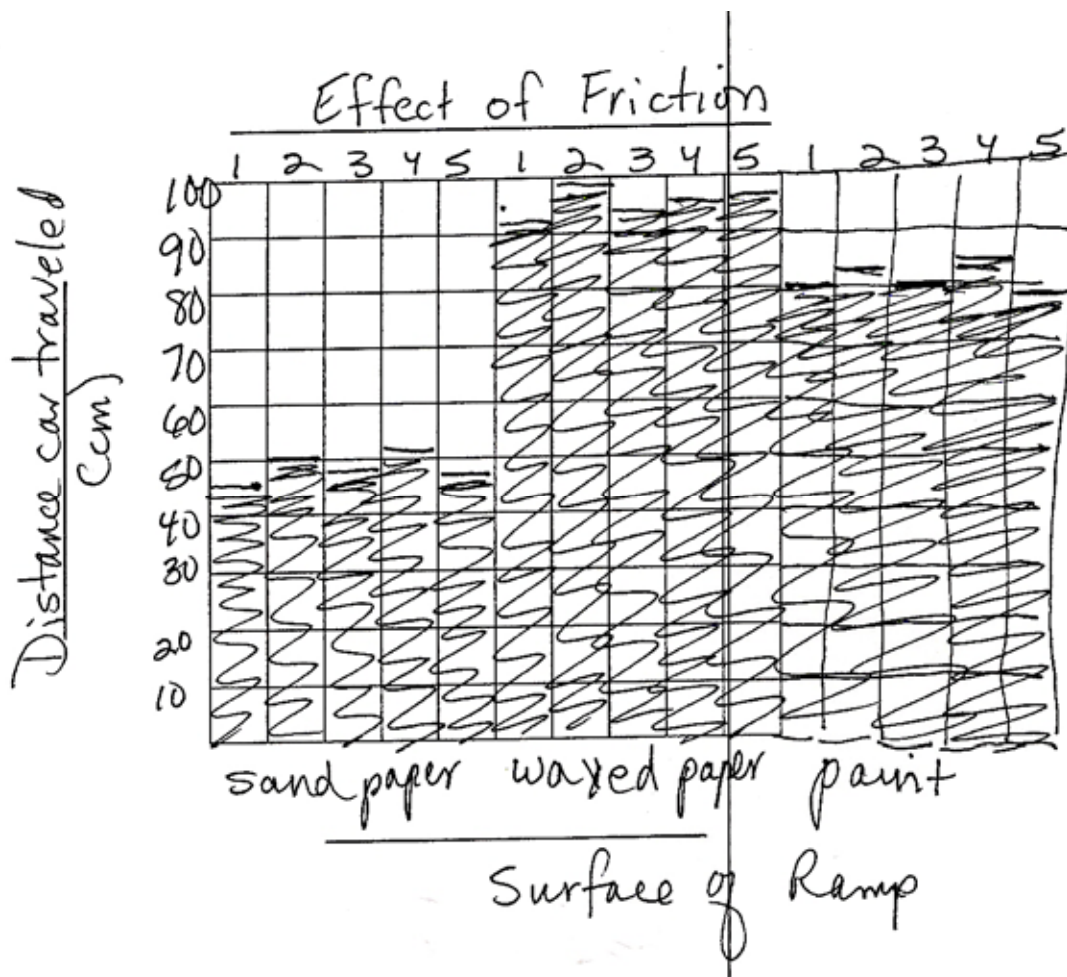


Graph 7

3 points

- **an appropriate title** (acceptable as a statement of what is being tested)
 - **a label for each axis with appropriate units**
 - **an appropriate number scale and category labels**
- Student receives no point for plotting of data. The student plotted all the data except the averages. Points were not taken off for extending the graph, only for omitting the plots for averages.

Suggestion: Emphasize the importance of reading the prompt carefully. Discuss the role of averages in communicating data rather than using the results of all trials.



Writing a Conclusion

A conclusion should be a simple sentence indicating the extent that the data supported the hypothesis. It should describe any relationship found between the independent and dependent variables.

4. Use the data from the data table and graph to write a conclusion for the experiment on friction.
-
-

Exemplary response:

The lower the friction, the greater the distance traveled by the car.

OR

The greater the friction, the less distance traveled by the car.

Acceptable response:

The less friction there is, like on waxed paper, the more the car traveled. The car didn't go very far with more friction, like on the sandpaper.

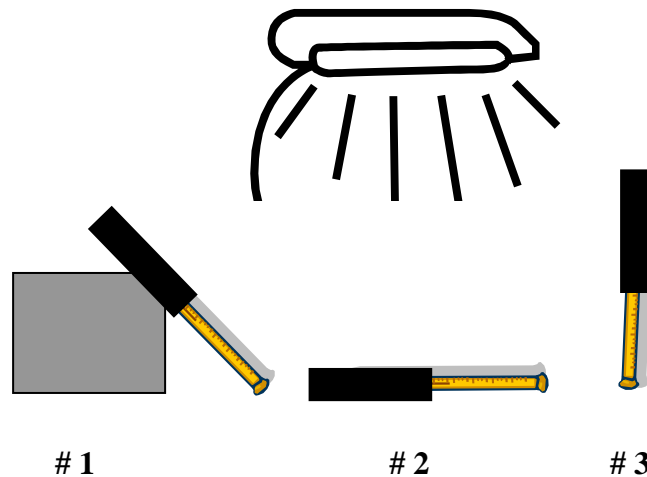
No point earned: Unacceptable response (doesn't provide the relationship between the variables):

They proved that friction does make a difference.

Light Energy

The class decided to investigate light to see if the angle of the light made a difference in the amount of energy that was absorbed from the light. The designed the experiment using the following procedure:

1. They put a thermometer in each of three pieces of black paper.
2. They placed each thermometer under a bright lamp.
3. Each thermometer was placed at a different angle so the light would hit each one differently (one was tilted at a 45° angle on a box, one was placed flat on the tabletop, and one was placed standing straight up).
4. The students recorded the temperature of each thermometer every five minutes.
5. The experiment was repeated three times for a total of 20 minutes.



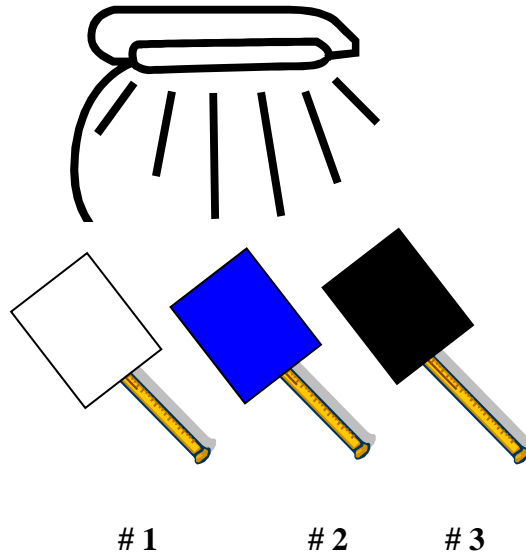
1. Construct a data table in the space below that would compare the angle of light with the amount of energy absorbed. The data table should be designed so that other students could use it to record and analyze the data collected during the experiment. Be sure to label rows and columns appropriately.

2. Write a reasonable hypothesis for this experiment.

3. The class will need to conduct a fair experiment. Describe two factors they will need to control (keep the same) in the experiment above to make the experiment fair.

4. Why is it important to control all the variables except one in the experiment?

The class wanted to do another experiment to see if the color of paper makes a difference in how much energy is absorbed by the light. They set up the experiment with three thermometers set the same distance from a lamp. Each thermometer was wrapped in different colors of paper.



5. Identify two factors that will need to be measured during the experiment.
Next to each one, identify the tool they will need to use.

Factor to be measured

Tool needed for measure

1. _____

2. _____

ANCHOR PAPERS FOR DATA TABLES

Generic Scoring Guide for DATA TABLES, Grade 8

Two Total Points

One point for each of the following:

Point 1:

The **row or column headings indicate what information is to be manipulated and recorded relative to the independent variable** (can be a descriptive heading with units, if appropriate, or the conditions to be varied may be written in).

AND

The **row or column headings indicate what information is to be observed and recorded relative to the dependent variable** (can be a descriptive heading with units, if appropriate, or the conditions to be varied may be written in).

Point 2:

Data table is **organized to allow for collection and analysis of data relevant to the experiment**

Prompt reads:

Construct a data table in the space below that would compare the (IV) and (DV). The data table should be designed so that other students could use it to record and analyze the data collected during the (new) experiment. Be sure to label rows and columns appropriately.

Ideally the experimenter should be able to identify all of the main components of the experiment in the data table without reference to the prompt. These components include: the independent variable, values of the independent variable to be tested, the kind of results (data related to the dependent variable) to be observed, the number of trials or measurements to be recorded, and the units of measure. The data table should allow for easy comparison of results for the different values of the independent variable.

Common Errors:

- Headings do not indicate what type of data is to be recorded (e.g., temperature, distance, height)
- Units are not provided for measurements (either in the row or column headings or in the spaces provided for the values of the independent/dependent variables)
- Sufficient rows or columns are not provided for recording data specific to the independent variable values or number of trials/measurements identified in the description of the experiment

- Graphs are created instead of data tables
- Rows and columns are not arranged so that the results for the different values of the independent variable can be easily compared (e.g., data for each value is recorded in a separate table; each trial or measurement is recorded in a separate table)

Exemplary response:

Angle of Light (or Position of Thermometer)	Temperature (° C)			
	5 min	10 min	15 min	20 min
Tilted				
Horizontal				
Vertical				

1 point:

Rows and Column headings indicate what information is to be manipulated and recorded relative to the independent variable and dependent variables

- Data table is NOT organized to allow for collection and analysis of data relevant to the experiment (missing columns for multiple readings every five minutes)

4. Construct a data table for the students to use for their data. Be sure

Thermometer	Temperature C
1	
2	
3	

1 point:

Data table is organized to allow for collection and analysis of data relevant to the experiment

- Rows and Column headings do NOT indicate what information is to be manipulated and recorded relative to the independent variable and dependent variables (temperatures in degrees Celsius)

4. Construct a data table for the students to use for their data. Be sure to label all rows and columns

	5 min	10 min	15 min	20 min	25 min
Thermometer 1					
Thermometer 2					
Thermometer 3					

0 points:

- Data table is not organized to allow for collection and analysis of data relevant to the experiment (missing column for fourth measurement)
- Rows and Column headings do not indicate what information is to be manipulated and recorded relative to the independent variable and dependent variables (temperatures)

	Experiment 1	Experiment 2	Experiment 3
thermometer A			
thermometer B			
thermometer C			

1 point:

Data table is organized to allow for collection and analysis of data relevant to the experiment

- Rows and Column headings do not indicate what information is to be manipulated and recorded relative to the independent variable and dependent variables (temperatures)

For the students to use for their data. Be sure to label all rows and columns

Time (min)	standing up thermometer	laying down thermometer	leaning thermometer
5			
10			
15			
20			
25			

0 points:

- Data table is NOT organized to allow for collection and analysis of data relevant to the experiment
- Rows and Column headings do not indicate what information is to be manipulated and recorded relative to the independent variable and dependent variables (temperatures)

Supplies	time
Black paper	5 mins
thermometer	5 mins
Light	5 mins
paper	5 mins
pen	
clock	

1 point:

Rows and Column headings indicate what information is to be manipulated and recorded relative to the independent variable and dependent variables

- Data table is NOT organized to allow for collection and analysis of data relevant to the experiment (independent variable is identified twice, no columns for multiple temperature readings are available)

Experiment #	°C	Angle of hit by light by degrees
Thermometer 1		
Thermometer 2		
Thermometer 3		

6. Write a reasonable hypothesis for this experiment:

0 points:

- Data table is NOT organized to allow for collection and analysis of data relevant to the experiment (no column for 20 minute reading, not organized for comparison of different thermometers)
- Rows and Column headings do not indicate what information is to be manipulated and recorded relative to the independent variable and dependent variables (does not indicate that the independent variable is the angle of light/different thermometers)

1st time

	5min	10mins	15min
1 Temp			
2 temp			
3 temp			

2nd time

	5min	10mins	15mins
1 temp			
2 temp			
3 temp			

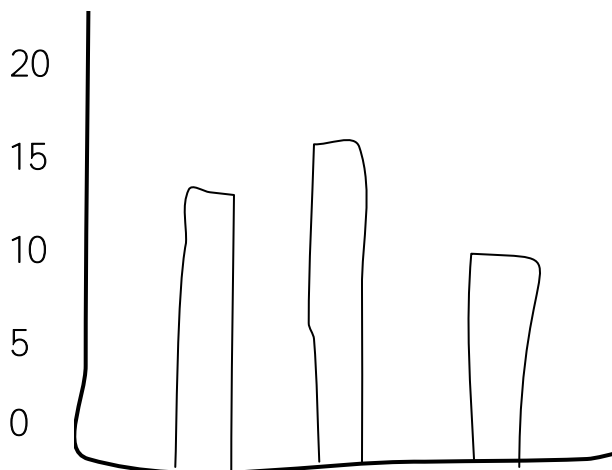
3rd time

	5min	10min	15min
1 temp			
2 temp			
3 temp			

6. Write a reasonable hypothesis for this experiment.

0 points:

- Graph, not a data table



1 point:

Rows and Column headings do not indicate what information is to be manipulated and recorded relative to the independent variable and dependent variables (thermometers; temperatures)

- Data table is not organized to allow for collection and analysis of data relevant to the experiment (temperatures every 5 minutes, NOT 3 trials)

Thermometer	Trial 1		Trial 2		Trial 3	
	Beg. Temp	End Temp	Beg. Temp	End Temp	Beg. Temp	End Temp
1						
2						
3						
Wavy line						

1 point:

Data table is organized to allow for collection and analysis of data relevant to the experiment

- Rows and Column headings indicate what information is to be manipulated and recorded relative to the independent variable and dependent variables

Angle of thermometer	after 5 min	after 10 min	after 15 min
Angle 1			
Angle 2			
Angle 3			

ANCHOR PAPERS FOR SCORING ITEMS ASSESSING TESTABLE HYPOTHESES

Generic Scoring Guide for Testable Hypotheses

Testable Hypothesis:

Any reasonable hypothesis based on the testable question or statement of a problem that predicts an effect, or the lack of effect, of the independent variable on the dependent variable

Exemplary responses take these appropriate forms:

“If (independent variable) (description of change in (IV)), then (dependent variable) (description of effect)”

“As the (independent variable) (description of change)s, the (dependent variable) (description of change)s”

“The (qualitative/quantitative change in independent variable) of (independent variable), the (quantitative change in dependent variable)”

B. What is the hypothesis for this investigation?

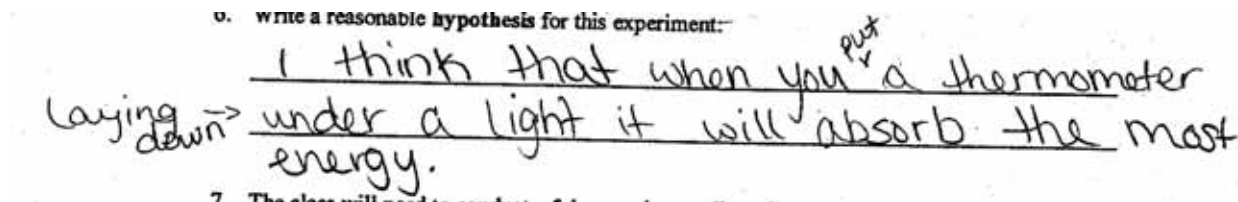
Common errors

- Response does not provide a specific, directional prediction (e.g., prediction fails to identify how the dependent variable will be affected by the independent variable; prediction is vague as it does not specify how the change will differ from the expected results to be observed in the control group)
- Response does not suggest a specific, quantifiable change in the dependent variable (e.g., predicts a “better/best” effect which does not suggest “how” the effect would be better; predicts that the independent variable will “affect/help/change _(DV)_ more/the most,” which does not specify what will be changed and/or how)
- Prediction does not relate to problem or question asked (e.g., may predict a change in a dependent variable different from the change specified in the problem)
- Provides a reason for change instead of a prediction of change
- Prediction is vague due to use of pronouns (it, they) instead of using specific nouns to distinguish between the independent variable and dependent variable
- Provides another question or statement of the problem instead of a hypothesis

Exemplary Response:

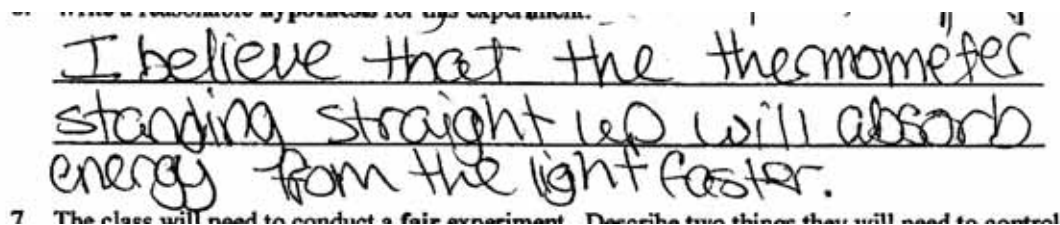
1 point:

Predicts an effect, or the lack of effect, of the independent variable (thermometer laying down) on the dependent variable(will absorb the most energy) related to the testable question or statement of a problem



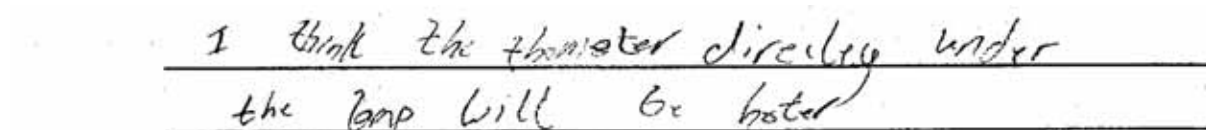
1 point:

Predicts an effect, or the lack of effect, of the independent variable (thermometer standing straight up) on the dependent variable(will absorb energy faster) related to the testable question or statement of a problem



1 point:

Predicts an effect, or the lack of effect, of the independent variable (thermometer directly under lamp) on the dependent variable(will be hotter) related to the testable question or statement of a problem



0 point:

Prediction is not directional (does not specify which thermometer would be the starting or low temperature)

“Turn the thermometer” is unclear as to which position is being addressed.

o. write a reasonable hypothesis for this experiment:

My hypothesis is that every time you turn the thermometer it will go up & every time.

1 point:

Predicts an effect, or the lack of effect, of the independent variable (thermometer directly under lamp) on the dependent variable (will get the most heat) related to the testable question or statement of a problem

My hypothesis is that the thermometer in direct light will get the most heat and the thermometer on the right will get the less heat, because it is standing straight

0 point:

Does not predict an effect, or the lack of effect, of the independent variable (the one horizontal thermometer) on the dependent variable related to the testable question or statement of a problem

I think the one horizontal thermometer

0 point:

Does not predict an effect, or the lack of effect, of the independent variable on the dependent variable related to the testable question or statement of a problem

If you have 3 thermometers at three different angles then they all should have different temps.

0 point:

Does not predict an effect, or the lack of effect, of the independent variable (all thermometers are under the lamp) on the dependent variable related to the testable question or statement of a problem

I think the one under the lamp will be the one with the highest temp.

1 point:

Does predict an effect, or the lack of effect, of the independent variable (Thermometer 2 position) on the dependent variable related to the testable question or statement of a problem

I think Thermometer 2 will be the hottest.

0 point:

Does not predict an effect, or the lack of effect, of the independent variable (which thermometer do they think is closer) on the dependent variable related to the testable question or statement of a problem

I believe that if the thermometer is closer to the light then it will get more heat.

7. The class will need to conduct a fair experiment. Describe how they will need to conduct

ANCHOR PAPERS FOR SCORING ITEMS ASSESSING TESTABLE QUESTIONS AND HYPOTHESES

Generic Scoring Guide for Testable Questions

Testable Question:

Any reasonable testable question about ____ that:

- identifies what will be tested or measured
- will generate quantifiable data
- has a control or comparison inherent in the question

(Scoring note: Statements of a problem, which meet the criteria for a testable question, will be allowed)

A. Write a question that could be the basis of your investigation

Common errors

- Response does not identify what is to be tested or measured (e.g., affect of independent variable on dependent variable)
- Response does not identify what quantifiable data will be collected
- Suggests an vague change instead of a specific, measurable change in the dependent variable (e.g., “what will happen if the (IV) is changed?” does not identify a measurable dependent variable)
- Response does not suggest a comparison between the control and experimental group(s)
- Response does not suggest a problem (instead may be a prediction)
- Problem is vague due to use of pronouns (it, they) instead of using specific nouns to identify the independent variable and dependent variable

Generic Scoring Guide for Testable Hypotheses

Testable Hypothesis:

Any reasonable hypothesis based on the testable question or statement of a problem that predicts an effect, or the lack of effect, of the independent variable on the dependent variable

Exemplary responses take these appropriate forms:

“If (independent variable) (description of change in independent variable), then (dependent variable) (description of effect)”

“As the (independent variable) (description of change)s, the (dependent variable) (description of change)s”

“The (qualitative/quantitative change in independent variable) of (independent variable), the (quantitative change in dependent variable)”

B. What is the hypothesis for this investigation?

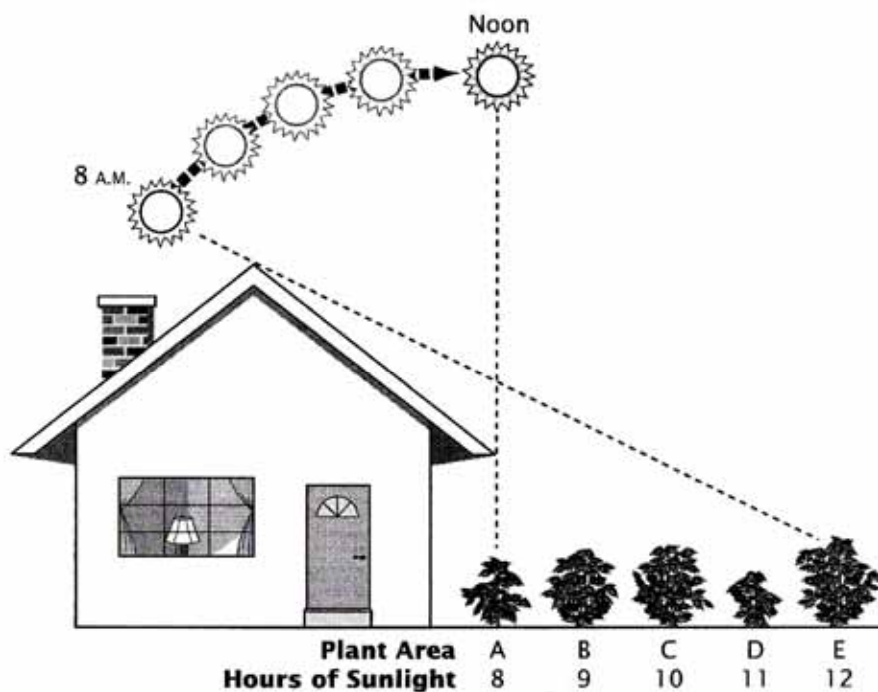
Common errors

- Response does not provide a specific, directional prediction (e.g., prediction fails to identify how the dependent variable will be affected by the independent variable; prediction is vague as it does not specify how the change will differ from the expected results to be observed in the control group)
- Response does not suggest a specific, quantifiable change in the dependent variable (e.g., predicts a “better/best” effect which does not suggest “how” the effect would be better; predicts that the independent variable will “affect/help/change (DV) more/the most,” which does not specify what will be changed and/or how)
- Prediction does not relate to problem or question asked (e.g., may predict a change in a dependent variable different from the change specified in the problem)
- Provides a reason for change instead of a prediction of change
- Prediction is vague due to use of pronouns (it, they) instead of using specific nouns to distinguish between the independent variable and dependent variable
- Provides another question or statement of the problem instead of a hypothesis

Ada's Tomatoes

Four things affect plant growth: sunlight, water, air, and soil. Ada planted tomatoes in her garden. She chose to investigate the effect of the amount of sunlight on the size of the tomatoes.

Ada planted five tomato plants at different distances from her house. The picture below shows how the shadow of the house moves across the garden from 8:00 A.M. to noon. The plants closest to the house get the fewest hours of sunlight. The plants farthest from the house get the most hours of sunlight.



DO NOT WRITE HERE

- 7** Ada decided to repeat her experiment using 100 tomato plants instead of 5. Why is it a good idea to use many plants instead of a few?

- 8** Ada read that the type of fertilizer can affect the size of tomatoes. She decided to compare organic fertilizer and chemical fertilizer.

- (a) Write a correctly worded question that could be the basis of her scientific investigation.

- (b) Write a correctly worded hypothesis for the question you wrote above.

- 9** What will be the independent and dependent variables in the experiment suggested in Number 8?

Independent variable _____

Dependent variable _____

Session:	2
Item No.:	7
Page No.:	6
Standard:	II.B.1 (Std 7)
Goals:	1.3, 3.4

Key Element:

Any one of the following:

- A larger sample size gives more reliable data.
 - More plants make one defective plant easier to dismiss.
 - Errors have less effect on results if averaged with a large number of correct data.
-

Score Points:

1 point	one key element
0 points	other

Session:	2
Item No.:	8
Page No.:	6
Standard:	II.B.1 (Std 7)
Goals:	1.1

Key Elements:

(a) either one of the following:

- How does fertilizer type affect tomato size/plant size?
- any question that implies fertilizer as the independent variable and tomato size/plant size as the dependent variable

Note: The question must be testable.

(b) any one of the following:

- Chemical fertilizer will produce bigger tomatoes than organic fertilizer.
 - Organic fertilizer will produce bigger tomatoes than chemical fertilizer.
 - Tomato size/plant size is not related to fertilizer type.
-

Score Points:

2 points	two key elements
1 point	one key element
0 points	other

Session:	2
Item No.:	9
Page No.:	6
Standard:	II.B.1 (Std 7)
Goals:	1.3

Key Elements:

(Independent variable) fertilizer type

(Dependent variable) tomato size/plant size

Score Points:

2 points	two key elements
1 point	one key element
0 points	other

- (a) Write a correctly worded question that could be the basis of her scientific investigation.

Can two different fertilizers like organic + chemical fertilizer affect the size of tomatoes?

- (b) Write a correctly worded hypothesis for the question you wrote above.

If organic + chemical fertilizers were tested to see if it affected the growth of tomatoes, then organic would work better

Score Point 2

2 Key Elements

>A testable question that implies fertilizer as the independent variable and tomato size as the dependent variable.

>"Better" is defined as "more growth", i.e. larger (in this context)]

Hypothesis receives credit because "better growth" is interpreted as related to "size of tomatoes" as defined in the testable question. Thus, the scoring of both is linked in this case.

- (a) Write a correctly worded question that could be the basis of her scientific investigation.

What kind of fertilizer affects the size of a tomato, organic or chemical fertilizer.

- (b) Write a correctly worded hypothesis for the question you wrote above.

I think organic fertilizer would affect the size of a tomato.

Score Point 1

1 Key Element

>A testable question that implies fertilizer as the independent variable and tomato size as the dependent variable.

>[too vague - does not specify the effect of fertilizer on tomato size]

- (a) Write a correctly worded question that could be the basis of her scientific investigation.

When I use the chemical fertilizer will my tomatoes grow faster or bigger?

- (b) Write a correctly worded hypothesis for the question you wrote above.

I think If I used chemical fertilizer that my tomatoes would grow more slow.

Score Point 0

No Key Elements

>[too vague - faster or bigger than what?]

>[incorrect - "slow" is not what is being tested]

- (a) Write a correctly worded question that could be the basis of her scientific investigation.

Would a organic fertilizer or
a chemical fertilizer work better
on tomato plants.

- (b) Write a correctly worded hypothesis for the question you wrote above.

the chemical fertilizer would
work better because it has
specific chemicals that help
plants grow.

Score Point 0

No Key Elements

>[too vague - "work better" does not address size]

>[too vague - "work better" is not specific to size]

Which fertilizer will affect
the growth of the plants more:
organic or chemical?

(b) Write a correctly worded hypothesis for the question you wrote above.

I think that organic
fertilizer would affect the
plants more.

Score Point 0

No Key Elements

>["affect the growth" is not a clear reference to size; could be greener, healthier]

>[too vague to be a prediction of effect]

- (a) Write a correctly worded question that could be the basis of her scientific investigation.

Can the type of fertilizer affect the size of tomatoes?

- (b) Write a correctly worded hypothesis for the question you wrote above.

Does chemical or organic fertilizer affect the size of the plants?

Score Point 1

1 Key Element

>A testable question that implies fertilizer as the independent variable and tomato size as the dependent variable.

>[not a hypothesis; it's another question]

- (a) Write a correctly worded question that could be the basis of her scientific investigation.

Does organic or chemical fertilizer
grow the biggest size of tomato.

- (b) Write a correctly worded hypothesis for the question you wrote above.

If organic and chemical fertilizer are
test to see which will grow the biggest tomato,
then the chemical fertilizer will grown
the biggest tomato.

Score Point 2

2 Key Elements

>A testable question that implies fertilizer as the independent variable and tomato size as the dependent variable.

>Chemical fertilizer will produce bigger tomatoes than organic fertilizer.

- (a) Write a correctly worded question that could be the basis of her scientific investigation.

Which fertilizer is best for growing large tomatoes?

- (b) Write a correctly worded hypothesis for the question you wrote above.

I hypothesize the organic fertilizers will grow the largest tomatoes.

Score Point 2

2 Key Elements

- >A testable question that implies fertilizer as the independent variable and tomato size as the dependent variable.
- >Organic fertilizer will produce bigger tomatoes than chemical fertilizer.

- (a) Write a correctly worded question that could be the basis of her scientific investigation.

Which one of these fertilizers would work the best for the biggest sized tomato?

- (b) Write a correctly worded hypothesis for the question you wrote above.

I think that the organic fertilizer will work the best for the tomato plants.

Score Point 1

1 Key Element

>A testable question that implies fertilizer as the independent variable and tomato size as the dependent variable.

>[no reference to effect on size]

The scoring of the hypothesis is not linked to the testable question in this case, because the hypothesis now refers to the tomato plants in general, instead of tomato (fruit) size as mentioned in the question.

- (a) Write a correctly worded question that could be the basis of her scientific investigation.

Can the different types of fertilizers you use, change the way your plants grow.

- (b) Write a correctly worded hypothesis for the question you wrote above.

yes, the different types of fertilizers you use does change the growth rate of a plant.

Score Point 0

No Key Element

>[too vague]

>[incorrect: "growth rate" is not what is being tested]

- (a) Write a correctly worded question that could be the basis of her scientific investigation.

Does organic fertilizer help a tomato grow bigger or does chemical fertilizer make it grow bigger.

- (b) Write a correctly worded hypothesis for the question you wrote above.

I will test both to see which one works best and then use the one that works best.

Score Point 1

1 Key Element

>A testable question that implies fertilizer as the independent variable and tomato size as the dependent variable.

>[incorrect response - not a hypothesis]

- (a) Write a correctly worded question that could be the basis of her scientific investigation.

Which fertilizer affects the size most in tomatoes is it organic or chemical?

- (b) Write a correctly worded hypothesis for the question you wrote above.

The chemical fertilizer may effect the size in tomatoes because of all the different kinds of chemicals in the plant.

Score Point 1

1 Key Element

>A testable question that implies fertilizer as the independent variable and tomato size as the dependent variable.

>[does not compare; does not predict effect]

- (a) Write a correctly worded question that could be the basis of her scientific investigation.

Which fertilizer will grow the best tomatoes

- (b) Write a correctly worded hypothesis for the question you wrote above.

I guess that the chemical will work better because of the chemicals

Score Point 0

No Key Elements

>[no credit given - "best" is not necessarily larger]

>[too vague - makes no reference to size]

- (a) Write a correctly worded question that could be the basis of her scientific investigation.

What helps tomatoe plants grow better,
organic fertilizer or chemical fertilizer?

- (b) Write a correctly worded hypothesis for the question you wrote above.

I think chemical will work
better.

Score Point 0

No Key Elements

>[no credit given - "better" is not necessarily larger]

>[too vague - makes no reference to size]

- (a) Write a correctly worded question that could be the basis of her scientific investigation.

What would make the difference
in the growth of tomatoes
organic or chemical.

- (b) Write a correctly worded hypothesis for the question you wrote above.

I think the organic fertilizer
will work better than the
chemical fertilizer.

Score Point 0

No Key Elements

>[too vague - makes no reference to size]

>[too vague - makes no reference to size]

- (a) Write a correctly worded question that could be the basis of her scientific investigation.

Will it make a difference in
plant growth if organic fertilizer
is used instead of chemical fertilizer?

- (b) Write a correctly worded hypothesis for the question you wrote above.

Which works better as fertilizer,
organic or chemical fertilizers?

Score Point 0

No Key Elements

>[too vague - "will it make a difference...", how?]

>[incorrect response - "it will make a difference"]

- (a) Write a correctly worded question that could be the basis of her scientific investigation.

In which Fertilizers do the
tomato's grow better in.

- (b) Write a correctly worded hypothesis for the question you wrote above.

Set 2 plants in Fertilizer of both Chemical.
and Organic Each plant 3 Fertilizer in different Pots.
Give Each same amount of Water, Sunlight and Air.

Score Point 0

No Key Elements

>[no credit given - "better" is not necessarily larger]

>[incorrect response - description of an experiment not a hypothesis]

- (a) Write a correctly worded question that could be the basis of her scientific investigation.

What would make the difference
in the growth of tomatoes
organic or chemical.

- (b) Write a correctly worded hypothesis for the question you wrote above.

I think the organic fertilizer
will work better than the
chemical fertilizer.

Score Point 0

No Key Elements

>[too vague - makes no reference to size]

>[too vague - makes no reference to size]

- (a) Write a correctly worded question that could be the basis of her scientific investigation.

how can fertilizer help get the
tomatoes bigger then regular
boil.

- (b) Write a correctly worded hypothesis for the question you wrote above.

Score Point 0
No Key Elements
>[not a testable question]
>[blank]

- (a) Write a correctly worded question that could be the basis of her scientific investigation.

If you could only choose
one fertilizer which one
and why?

- (b) Write a correctly worded hypothesis for the question you wrote above.

Chemical fertilizer

Score Point 0

No Key Elements

>[incorrect response]

>[incorrect response]

- (a) Write a correctly worded question that could be the basis of her scientific investigation.

Why should you compare organic fertilizer & chemical fertilizer

- (b) Write a correctly worded hypothesis for the question you wrote above.

It can affect the size.

Score Point 0

No Key Elements

>[incorrect response - does not address affect of fertilizer on tomato size/plant size]

>[incorrect response] Information is provided in prompt - does not address problem being tested.

ANCHOR PAPERS FOR SCORING SINGLE LINE GRAPHS

2007-2010 MAP Assessments

Generic Scoring Guide for Single Line GRAPH, Grade 8

(10x10 grid provided with horizontal lines/spaces for labeling of axes and title, prompt designates bar or line graph to be constructed)

Four Total Points

One point for each of the following:

- **Appropriate title:** a statement of the relationship between the independent and dependent variables or a statement of what is being tested
- **Both axes correctly labeled, with units** if appropriate
- **Appropriate number scale(s) written along axis/axes:** numbers on the gridlines, numbers that allow all data to be plotted, consistently
- **All data points correctly plotted AND correctly connected by a line**

Prompt for line graph reads:

Use the data from Table ____ to construct a line graph on the grid below. (Customized information related to data to be plotted may be provided.)

Be sure to provide:

- an appropriate title
- a label for each axis with appropriate units
- an appropriate number scales
- correctly plotted data

Common errors on Line Graph

- Title provided is a “catchy name” instead of a description of the intent of the experiment (e.g., “(IV) compared to (DV),” “The effect of (IV) on (DV)”)
- Axes are not labeled with variable descriptions
- Units of measure are not provided
- No points or only some of the points are plotted correctly
- Points are not connected by a line
- Bars are plotted instead of points connected by a line
- Numbering of axes
 - is not consistently scaled
 - are not equally spaced
 - values do not allow for plotting of data
 - are not aligned with grid lines (e.g., written between lines so that value of line cannot be distinguished)

INTERMEDIATE PERFORMANCE EVENT

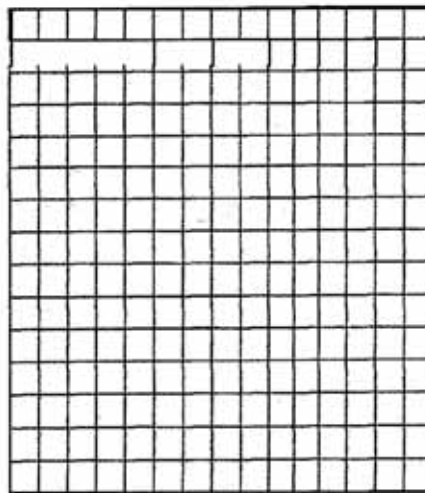
TULIPS

You are the owner of a company that supplies local florists with tulips. Last year the tulips you produced tended to be smaller than usual and you wonder if it had something to do with warmer soil temperature during the previous winter. The data below shows how the temperature of the ground in which tulip bulbs lie dormant in the winter **affects** the rate of growth of tulip plants.

HEIGHT OF TULIP PLANTS
ONE WEEK AFTER BREAKING THROUGH SOIL

	AREA A	AREA B	AREA C
Ground Temperature in Winter	7 C	2 C	0 C
Average Height of Plants	4 cm	8 cm	14 cm

1. Use the grid below to display the data from the chart as a line graph. Label and provide a number scale for each axis, and give your graph a title.



2. Based on the data on Page 2, describe the relationship between ground temperature in winter and the height of tulip plants after a week of visible growth.

3. Describe three variables other than winter ground temperature that might affect the rate at which tulip plants grow.

1.

2.

3.

4. Did the data on Page 2 convince you that winter ground temperatures affect the rate of growth of tulips? Explain your answer.

1. Four points

Key Elements:

accurately plotted points on a line graph

titled appropriately

both axes correctly labeled

both axes correctly scaled

Score Points:

4 points	four key elements
3 points	three key elements
2 points	two key elements
1 point	one key element
0 points	other

Note: Axis labeling does not have to include “cm” or “°C”; however, in this case, units must be given elsewhere on the graph to receive the “axis labeling point.”

2. One point

The lower the ground temperature the greater the height or vice versa

3. Threepoints-one for each of three answers

Air temperature
Soil type (mineral type)
Amount of water
Amount of sunlight
Type of tulip/tulip bulb
Parasites/pests
Use of fertilizers
Closeness of individual plants (density)
How deep the bulb was planted
Any obviously influential variable with respect to growth

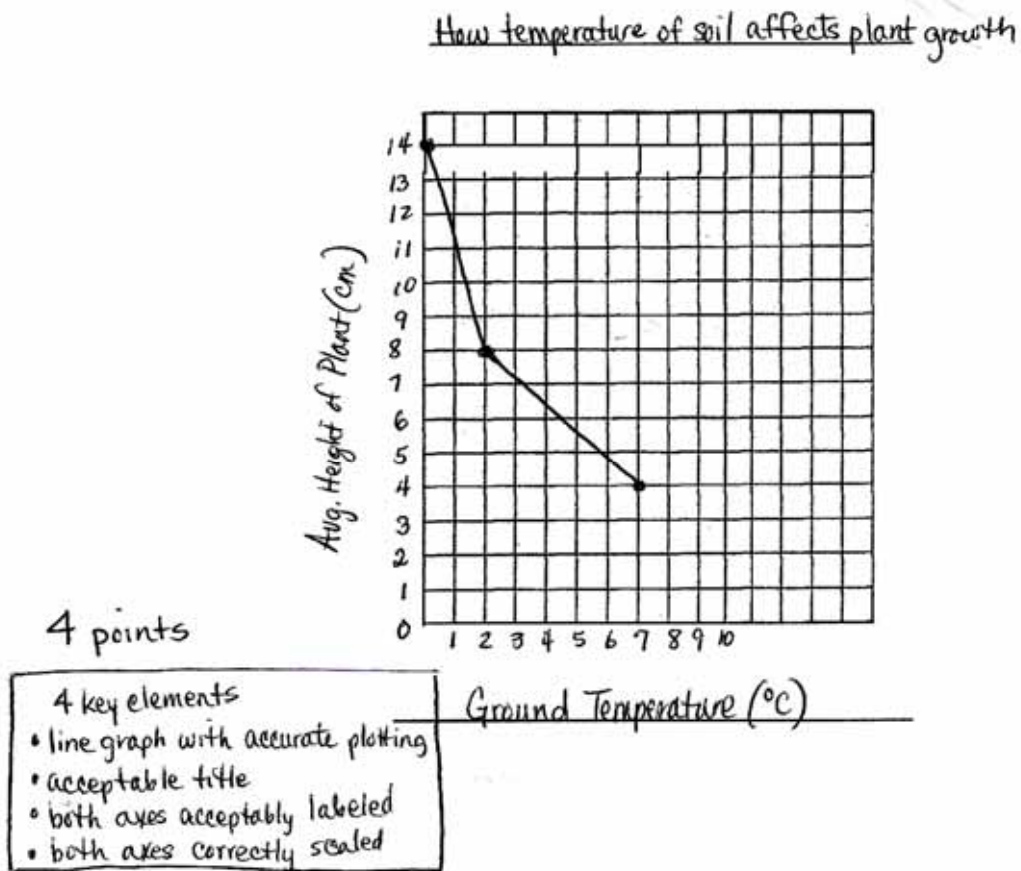
4. One point

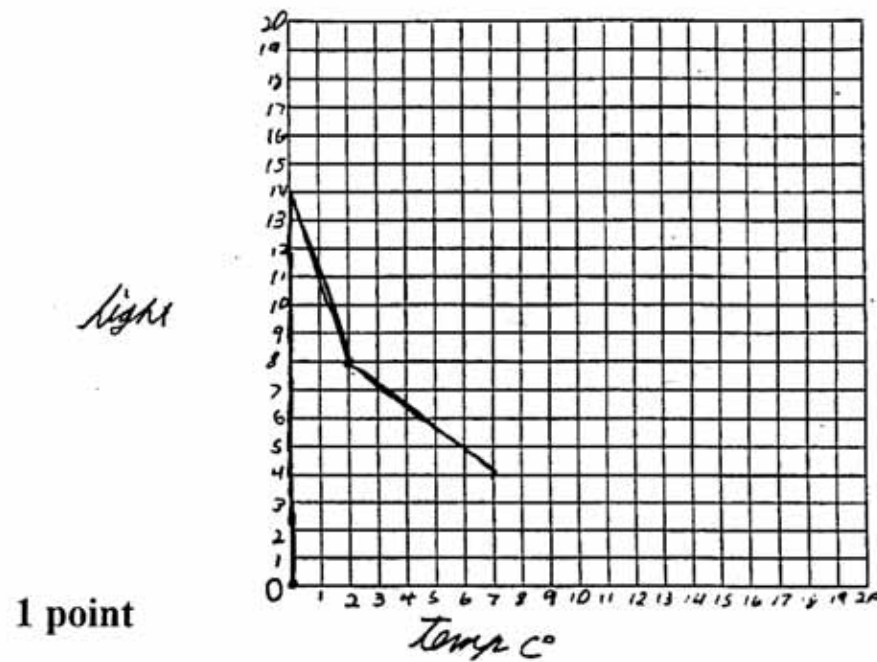
Yes AND tulips grew more when the ground temperature was colder

O R

No AND suggestion that not enough information is given about how the investigation was conducted to evaluate the quality of the data

Exemplary Response

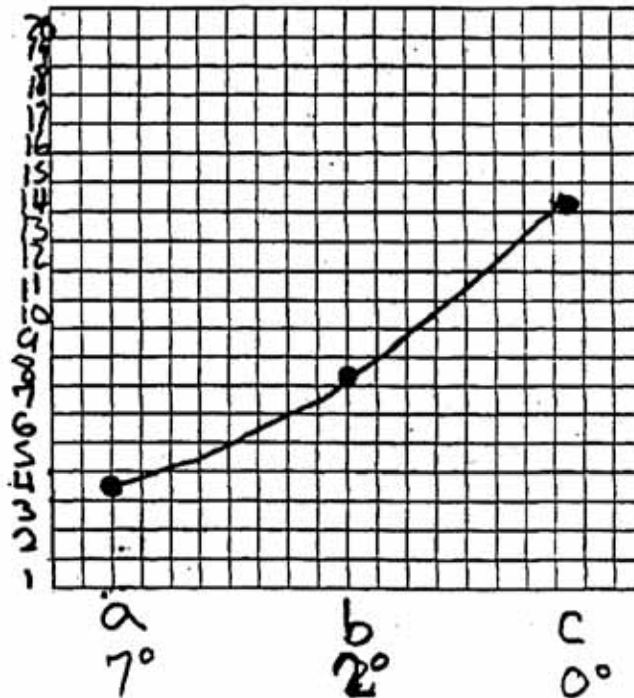




Doc # 083024
 1 key element

- [incorrect plotting]
- [missing title]
- [unacceptable axes labels (lacks 'cm')]
- both axes correctly scaled

TR 2-3 p 1

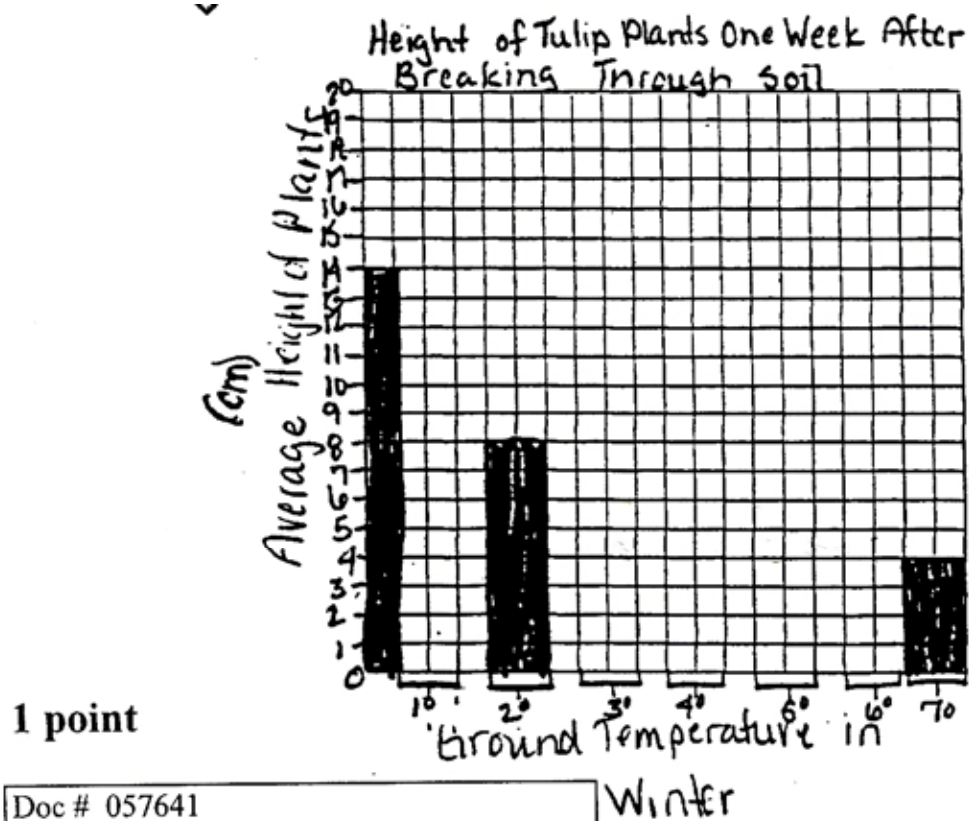


0 points

Doc # 199946

0 key elements

- [incorrect plotting]
- [missing title]
- [no axes labels]
- [incorrect scaling for at least one axis]



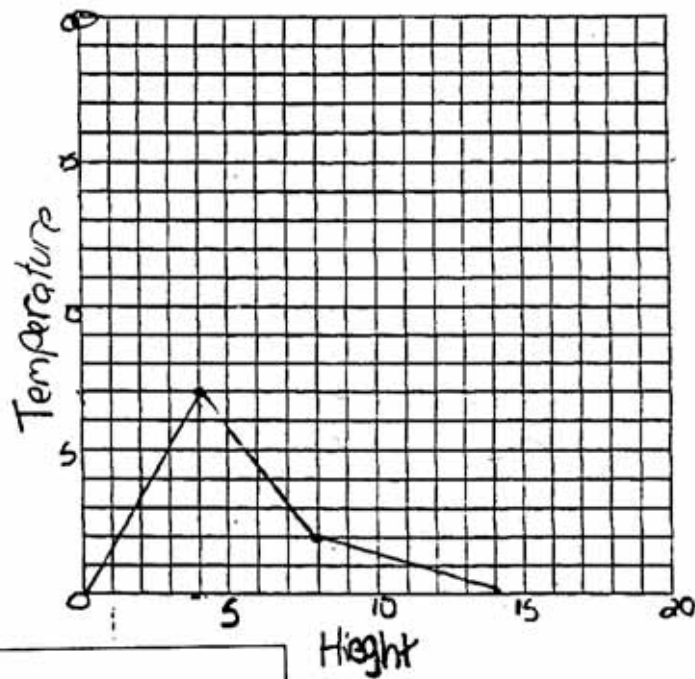
Doc # 057641

1 key element

- [not a line graph]
- acceptably titled
- [unacceptable axes labels (lacks "°C")]
- [incorrect scaling for at least one axis]

Winter

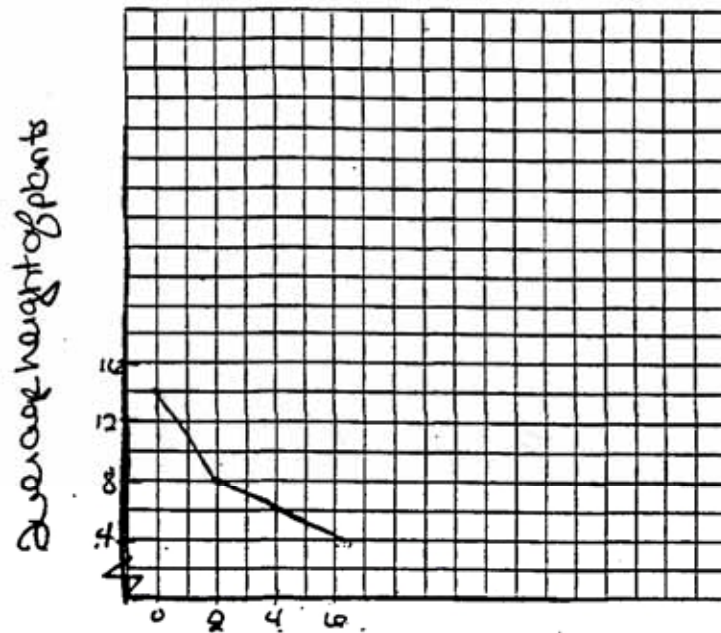
1 point



Doc # 072630

1 key element

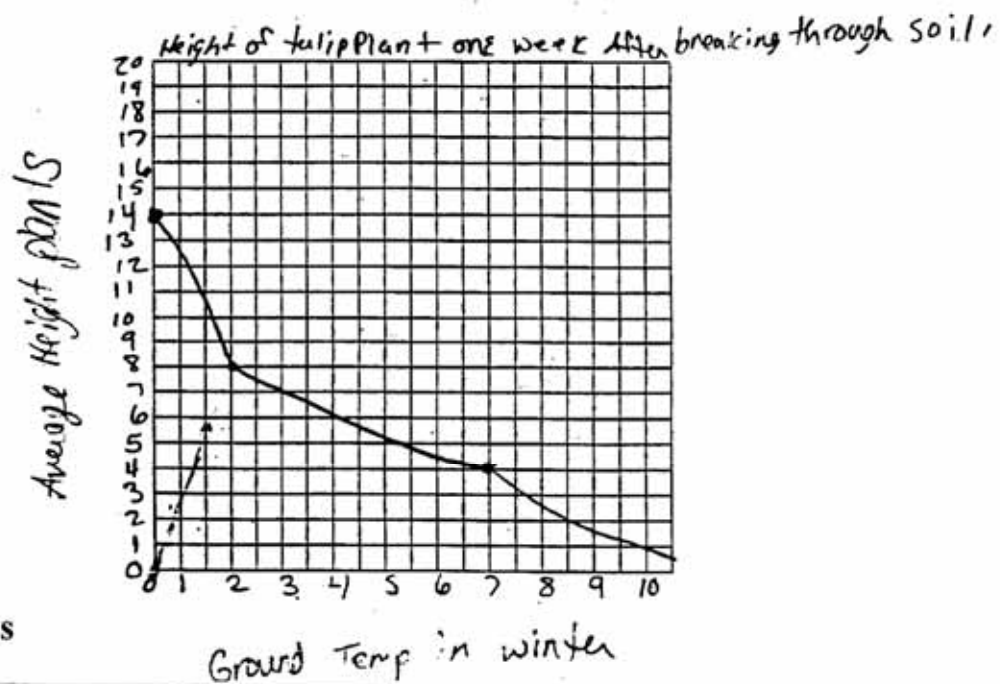
- [incorrect plotting]
- [missing title]
- [unacceptable axes labels (lacks units)]
- both axes correctly scaled



0 points

Ground temp.
in winter

Doc # 077996
0 key elements
<ul style="list-style-type: none"> • [incorrect plotting] • [missing title] • [unacceptable axes labels (lacks units)] • [incorrect scaling for at least one axis]



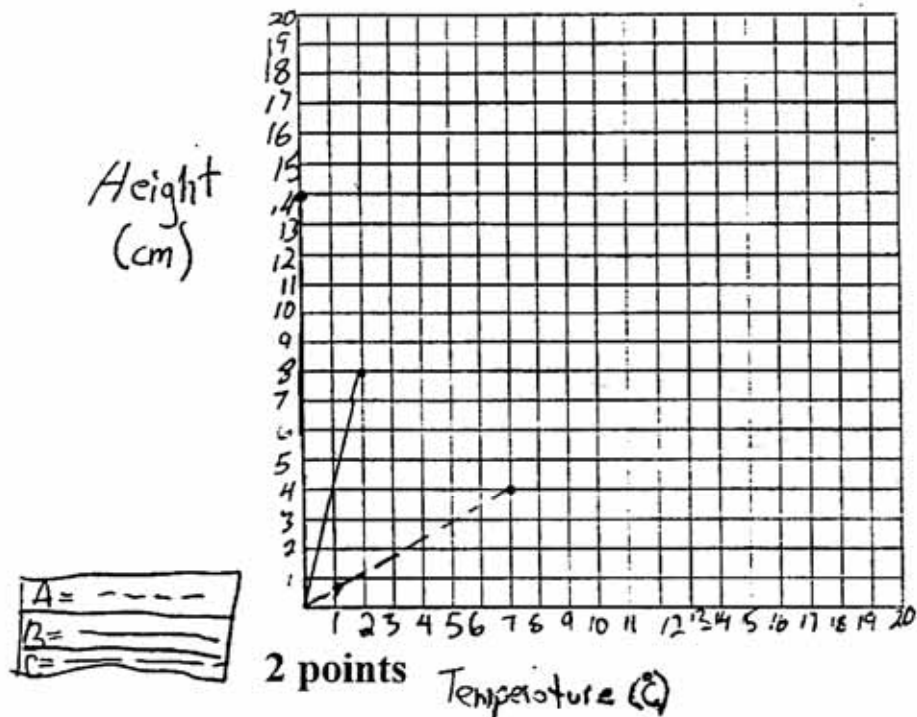
2 points

Doc # 075335

2 key elements

- [incorrect plotting]
- acceptably titled
- [unacceptable axes labels (lacks units)]
- both axes correctly scaled

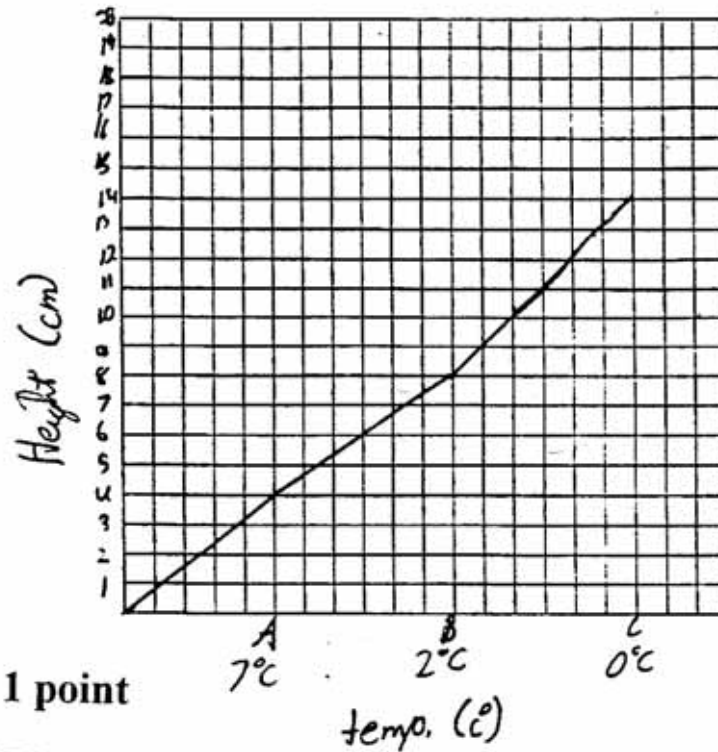
TR 2-3 p 10



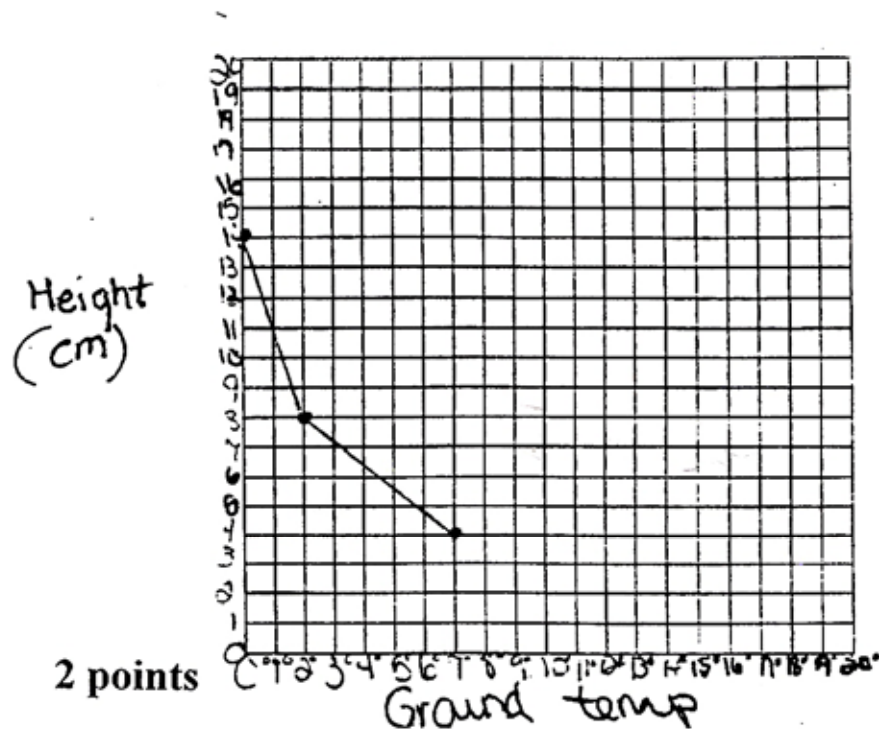
Doc # 072626

2 key elements

- [incorrect plotting]
- [missing title]
- both axes acceptably labeled
- both axes correctly scaled



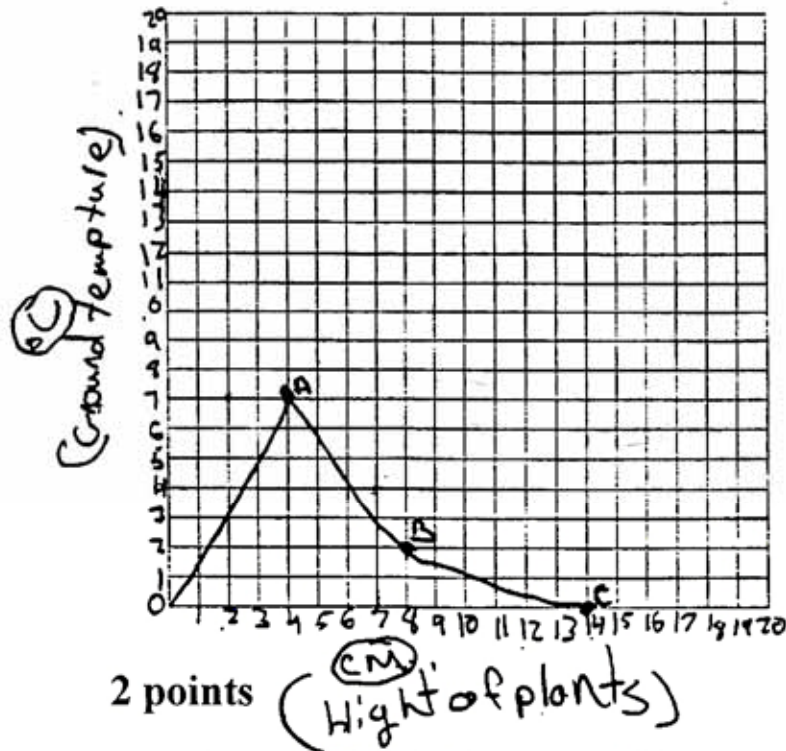
Doc # 064347
1 key element
<ul style="list-style-type: none"> • [incorrect plotting] • [missing title] • both axes acceptably labeled • [incorrect scaling for at least one axis]



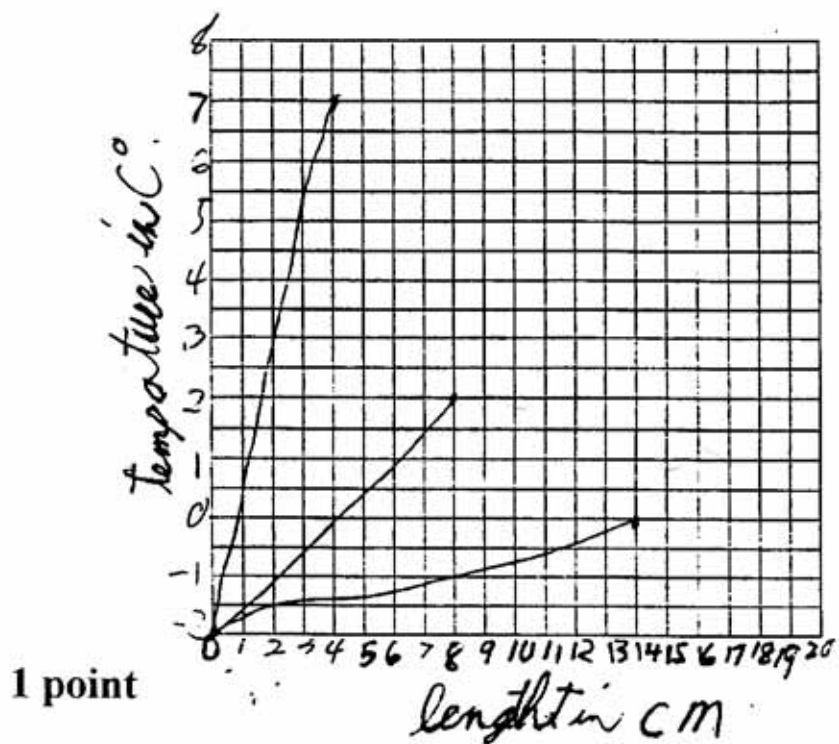
Doc # 074621

2 key elements

- line graph with accurate plotting
- [missing title]
- [unacceptable axes labels (lacks '°C')]
- both axes correctly scaled



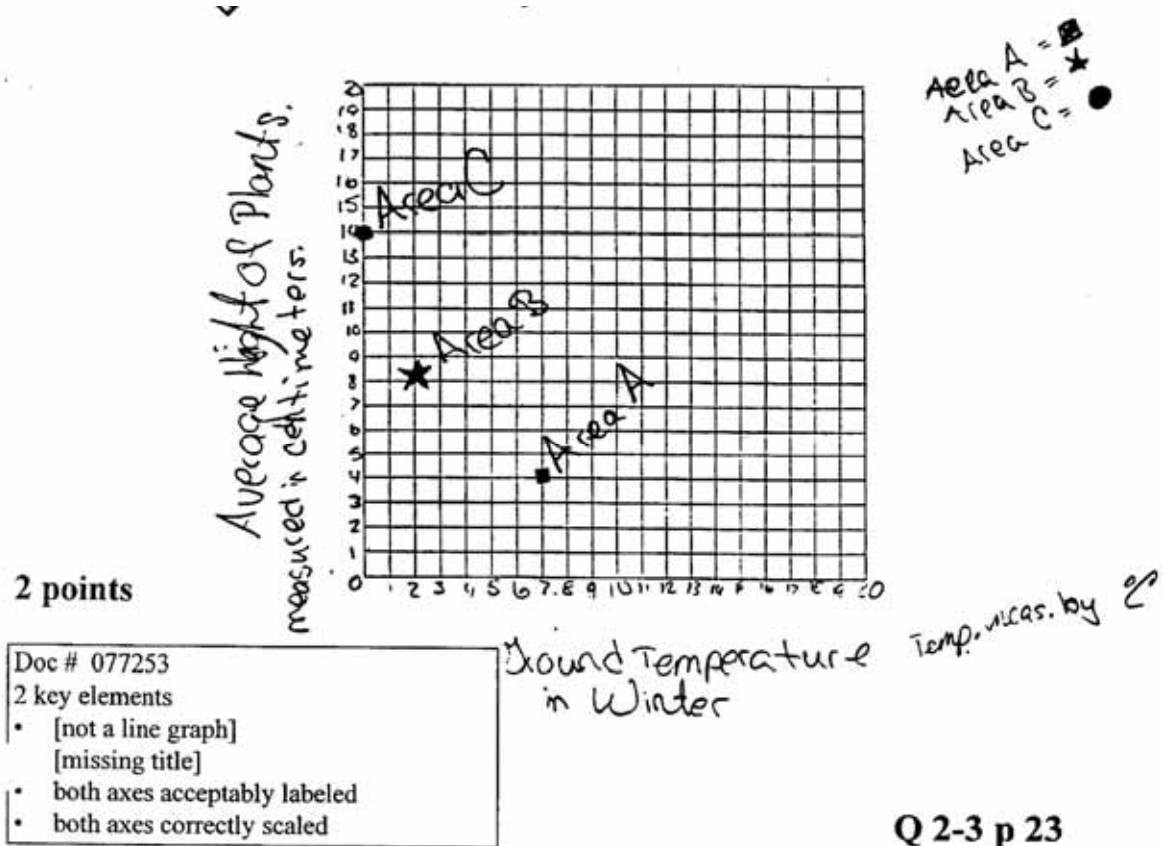
Doc # 198792
2 key elements
<ul style="list-style-type: none"> • [incorrect plotting] • [missing title] • both axes acceptably labeled • both axes correctly scaled

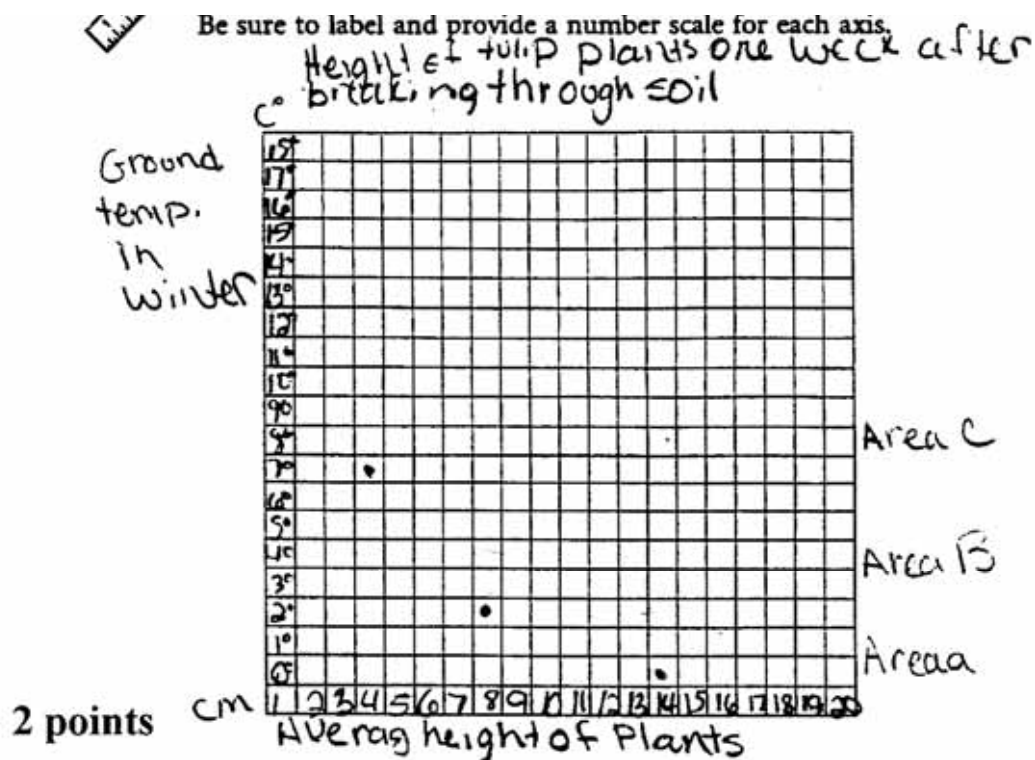


Doc # 075598

2 key elements

- [not a correctly plotted single line graph]
- [missing title]
- Both axes acceptably labeled
- Both axes correctly scaled (below zero temperature readings are possible)





Doc # 072383

2 key elements

- [incorrect plotting/not a line graph]
- acceptable title
- both axes acceptably labeled
- [incorrect scaling for at least one axis]